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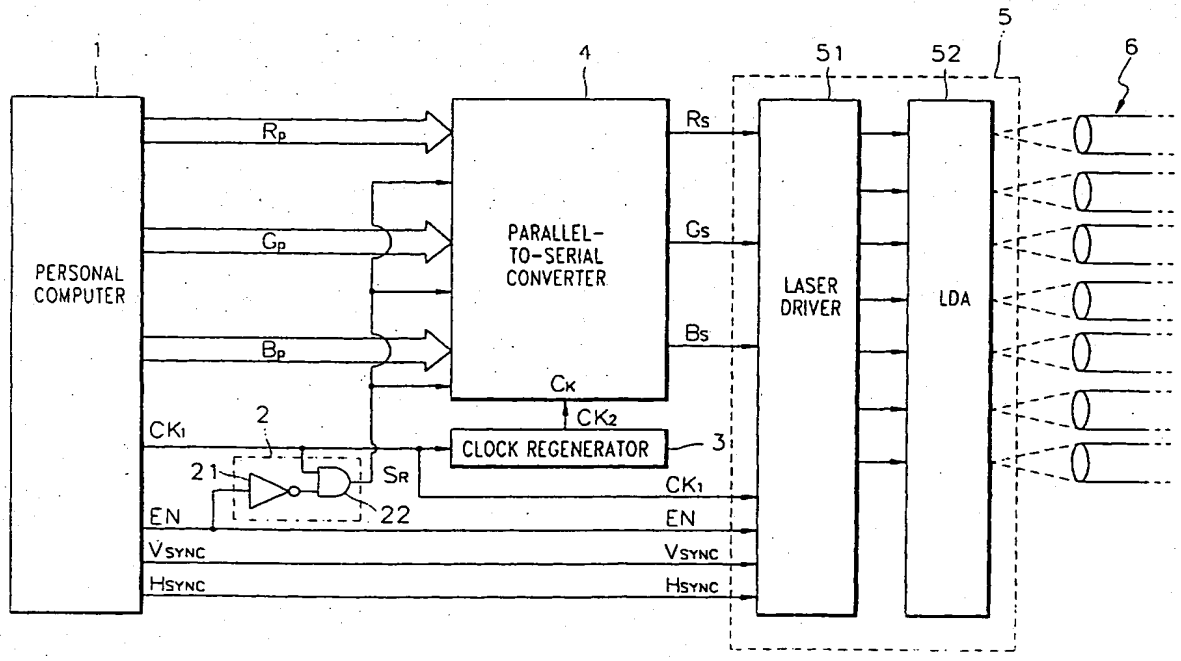
(54) Apparatus for transmitting image signals

(57) An apparatus for transmitting images over optical cables including a red image signal, a green image signal, and a blue image signal output from a personal computer, a clock signal indicative of the starting points of data frames of the image signals, an enable signal indicative of scan and blank periods of the image signals, a vertical synchronization signal and a horizontal synchronization signal. A reference signal generator (2) generates a reference signal (SR) having predetermined data when the blank period starts in accordance with an enable signal (EN). The reference signal is transmitted during the blank period between scan periods containing the red, green and blue image signals and can be used to resynchronise the phase of each image signal to correct for phase errors occurring during transmission.

FIG. 1



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Description

[0001] The present invention relates to an apparatus for transmitting image signals, and more particularly, to an apparatus for transmitting an N-bit red image signal, an N-bit green image signal and an N-bit blue image signal output from a computer system, clock signals indicative of frames of the image signals, enable signals indicative of the scan period and/or blank period of the image signals, vertical synchronization signals, horizontal synchronization signals and the like over an optical cable.

[0002] In transmitting image signals to a relatively distant location, the use of a conventional cable causes a voltage drop in a signal being transmitted due to line resistance of the cable. Thus, line drivers for compensating for the voltage drop are necessary. Also, in the case of transmitting a parallel image signal, since multiple channels are necessary, a large amount of materials for transmission cables are required. Accordingly, an apparatus of converting a parallel image signal into a serial image signal and transmitting the same over an optical cable has been proposed.

[0003] However, when an image signal is transmitted over an optical cable, skews in received signals may occur due to a difference in transmission speeds of the respective channels, which is because the individual properties of each emitter driving circuit, each received signal amplifying circuit, each emitting element or a receiving element are not homogeneous. If the level of the skew exceeds a predetermined value, the image of the received signal cannot be reproduced properly.

[0004] It is an aim of at least preferred embodiments of the present invention to provide an apparatus for converting a parallel image signal into a serial image signal and transmitting the same over an optical cable, wherein a difference in transmission speeds of the respective channels of the optical cable can be corrected.

[0005] According to the present invention there is provided an apparatus for transmitting image signals over optical cables as set forth in claim 1 or claim 2 appended hereto. Preferred features of the present invention will be apparent from the dependent claims and the description which follows.

[0006] Preferably, an apparatus is provided for transmitting over optical cables a red image signal, a green image signal, and a blue image signal output from a personal computer, a clock signal indicative of the starting points of data frames of the image signals, an enable signal indicative of scan and blank periods of the image signals, a vertical synchronization signal and a horizontal synchronization signal. The apparatus is characterized by comprising a reference signal generator, a parallel-to-serial converter and a light signal generator. The reference signal generator generates a reference signal having predetermined data when the blank period starts in accordance with the enable signal. The parallel-to-serial converter converts the reference signal corresponding to the blank period and the image signals corresponding to the scan periods into serial signals. The light signal generator converts the clock signal, the enable signal, the vertical synchronization signal, the horizontal synchronization signal and the serial signals output from the parallel-to-serial converter into light signals to then be incident into the optical cables.

[0007] Accordingly, since the reference signal is transmitted during the blank period, it is possible to measure a time interval between a reception point of the reference signal and that of the clock signal during each blank period. In other words, since the phase of each image signal is adjusted during each scan period, the difference in transmission speeds of the respective channels can be corrected.

[0008] Also according to the present invention there is provided an apparatus for transmitting image signals over optical cables, characterised by: a reference signal generator for generating a reference signal having predetermined data during a blank period determined in accordance with an enable signal.

[0009] Preferably, the reference signal generator is for generating the reference signal synchronised with the start of the blank period.

[0010] Preferably, the reference signal is generated for substantially the entire length of the blank period.

[0011] Preferably, the reference signal comprises a predetermined number of bits of data of a predetermined pattern.

[0012] Preferably, the reference signal is generated during the blank period such that the relative phase of each image signal may be adjusted during each scan period.

[0013] Preferably, the reference signal is arranged such that the time interval between the starting point of the first bit of the reference signal and the rising edge of a first clock signal (CK_1) can be measured to determine the relative phase of corresponding serial image signals ($R_sG_sB_s$) transmitted during a scan period determined in accordance with the enable signal.

[0014] Preferably, the reference signal generator comprises an inverter for inverting an enable signal (EN), and an AND gate coupled to an output of the inverter and to a clock signal (CK_1) to generate the reference signal (S_r).

[0015] Preferably, the apparatus is arranged to transit image signals output from a personal computer.

[0016] For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 is a block diagram illustrating an image signal transmitting apparatus according to a preferred embodiment of the present invention; and

Figure 2 is a timing diagram illustrating an example

of signals input to a laser driver of the transmitting apparatus shown in Figure 1.

[0017] Referring to Figures 1 and 2, the preferred image signal transmitting apparatus includes a reference signal generator 2, a parallel-to-serial converter 4 and a light signal generator 5. The apparatus transmits over optical cables 6 an 8-bit red image signal R_P, an 8-bit green image signal G_P, and an 8-bit blue image signal B_P, which are output from a personal computer 1, a first clock signal CK_1, a vertical synchronization signal V_{SYNC}, a horizontal synchronization signal H_{SYNC}, and an enable signal EN. The first clock signal CK_1 indicates the starting points of data frames for parallel image signals R_P, G_P and B_P. The enable signal EN notifies a reception side, for example, a monitor, of scan periods and blank periods of the parallel image signals R_P, G_P and B_P.

[0018] The reference signal generator 2 includes an inverter 21 and an AND gate 22, and generates a reference signal S_R having predetermined data when the blank period starts in accordance with the enable signal EN. The parallel-to-serial converter 4 converts the reference signal S_R corresponding to the blank period and the parallel image signals R_P, G_P and B_P corresponding to the scan periods into serial signals.

[0019] The light signal generator 5 converts the first clock signal CK_1, the enable signal EN, the vertical synchronization signal V_{SYNC}, the horizontal synchronization signal H_{SYNC} and the serial signals output from the parallel-to-serial converter 4 into light signals to then be incident into the optical cables 6.

[0020] For the signals output from the personal computer 1, the timing at which the first clock signal CK_1 is transited from a logic low state "0" to a logic high state "1" is the starting point of data frames of the parallel image signals R_P, G_P and B_P. Also, the period in which the enable signal EN is at a logic high state is the scan period, and the period in which the enable signal EN is at a logic low state is the blank period. Thus, during the blank period, the respective parallel image signals R_P, G_P and B_P are maintained at logic low states.

[0021] The inverter 21 of the reference signal generator 2 outputs a logic high signal during the blank period. Thus, when the blank period starts in accordance with the enable signal EN, the AND gate 22 generates a reference signal corresponding to the pulse of the first clock signal CK_1 being at a logic high state. A clock regenerator 3 drives the parallel-to-serial converter 4 by a second clock signal CK_2 whose frequency is 9 times higher than that of the first clock signal CK_1.

[0022] The parallel-to-serial converter 4 converts the reference signal S_R corresponding to the blank period and the parallel image signals R_P, G_P and B_P corresponding to the scan periods into serial signals. Accordingly, the respective signals output from the parallel-to-serial converter 4, that is, the respective serial image signals R_S, G_S and B_S, generate 9-bit data frames for one period of the first clock signal CK_1. In the respective data frames, the first bit is allocated so as to correspond to the reference signal S_R and the other 8 bits are allocated so as to correspond to the parallel image signals R_P, G_P and B_P. Thus, during the scan period in which the enable signal EN is at a logic high state, the first bits of the respective data frames are always at logic low states (see the portion a-b of Figure 2). Conversely, during the blank period in which the enable signal EN is at a logic low state, the first bits of the respective data frames are always at logic high states (see section j-k of Figure 2). In other words, during the blank period, all data frames have specific data structure of "100000000". Therefore, in a receiving apparatus (not shown) which receives light signals from the optical cables 6, when the data of "100000000" is first detected during the blank period, the time interval between the starting point of the first bit and the timing point of a rising edge of the first clock signal CK_1 can be measured. In accordance with the measured time interval, the phases of the corresponding serial image signals R_S, G_S and B_S can be adjusted, thereby correcting a difference in transmission speeds of the respective channels.

[0023] The light signal generator 5 includes a laser driver 51 and a laser diode array (LDA) 52. The laser driver 51 generates driving signals corresponding to the serial image signals output from the parallel-to-serial converter 4, the first clock signal CK_1, the enable signal EN, the vertical synchronization signal V_{SYNC} and the horizontal synchronization signal H_{SYNC}. The LDA 52 generates laser light signals by the driving signals of the laser driver 51. The light signals generated in the LDA 52 are incident into the corresponding optical cables 6 to then be transmitted to the receiving apparatus positioned at a monitor.

[0024] As described above, the image signal transmitting apparatus converts parallel image signals into serial image signals and transmits the same over optical cables. Thus, a difference in transmission speeds of the respective channels of the optical cables can be corrected, thereby minimizing skew of received signals to thus maximize the reproducibility of images.

[0025] Various changes and modifications may be made by those skilled in the art which do not go beyond the scope of the invention as defined in the appended claims.

[0026] The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0027] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0028] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0029] The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. An apparatus for transmitting over optical cables a red image signal, a green image signal, and a blue image signal, a clock signal indicative of the starting points of data frames of the image signals, an enable signal indicative of scan and blank periods of the image signals, a vertical synchronization signal and a horizontal synchronization signal, the apparatus characterized by comprising:

   a reference signal generator (2) for generating a reference signal having predetermined data when the blank period starts in accordance with the enable signal;

   a parallel-to-serial converter (4) for converting the reference signal corresponding to the blank period and the image signals corresponding to the scan periods into serial signals; and

   a light signal generator (5) for converting the clock signal, the enable signal, the vertical synchronization signal, the horizontal synchronization signal and the serial signals output from the parallel-to-serial converter into light signals to then be incident into the optical cables.

2. An apparatus for transmitting image signals over optical cables, characterised by:
   a reference signal generator (2) for generating a reference signal having predetermined data during a blank period determined in accordance with an enable signal.

3. An apparatus as claimed in claim 1 or 2, wherein the reference signal generator (2) is for generating the reference signal synchronised with the start of the blank period.

4. An apparatus as claimed in any of claim 1 to 3, wherein the reference signal is generated for substantially the entire length of the blank period.

5. An apparatus as claimed in any of claims 1 to 4, wherein the reference signal comprises a predetermined number of bits of data of a predetermined pattern.

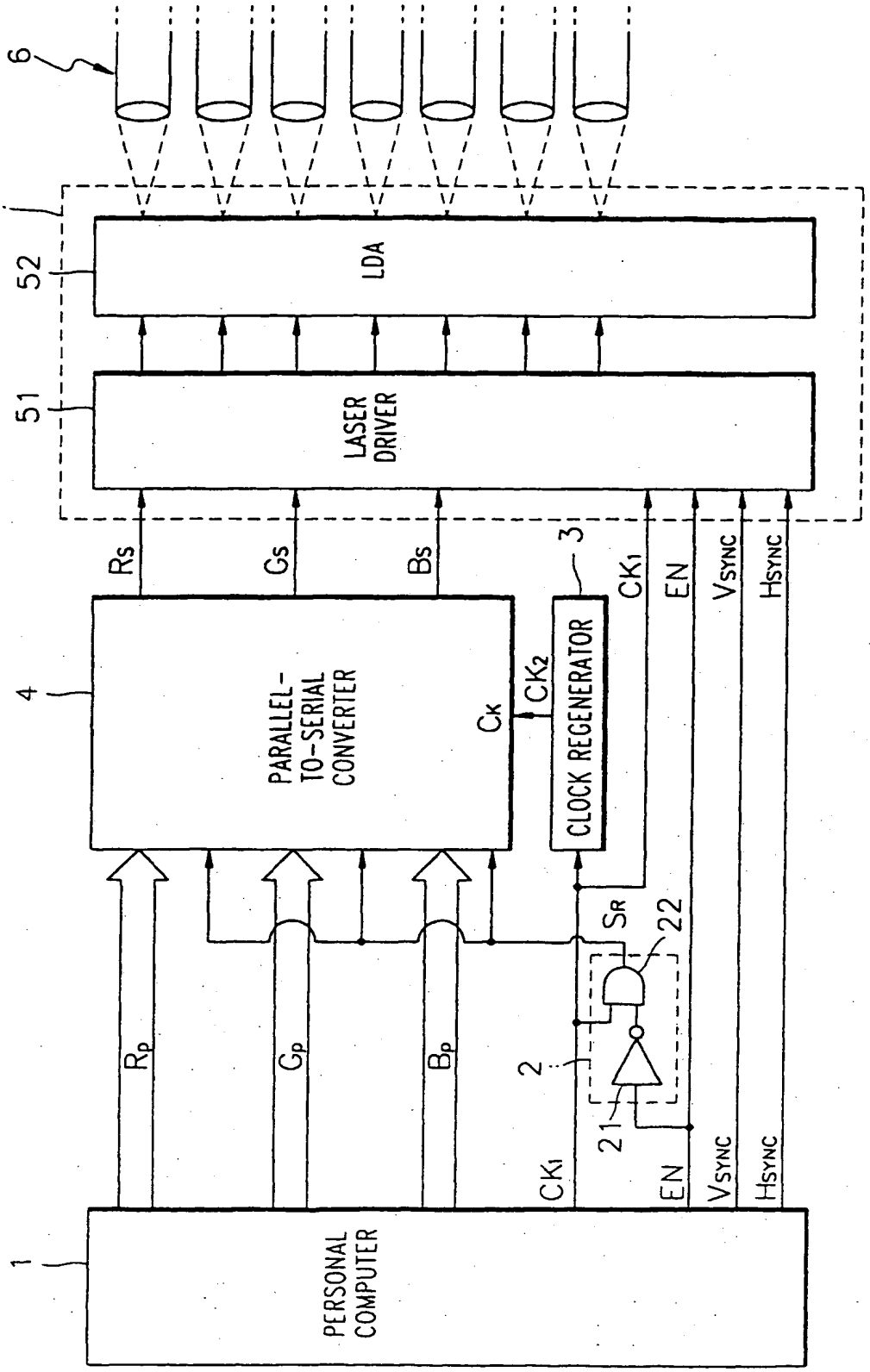
6. An apparatus as claimed in any of claims 1 to 5, wherein the reference signal is generated during the blank period such that the relative phase of each image signal may be adjusted during each scan period.

7. An apparatus as claimed in any of claim 1 to 6, wherein the reference signal is arranged such that the time interval between the starting point of the first bit of the reference signal and the rising edge of a first clock signal (CK_1) can be measured to determine the relative phase of corresponding serial image signals ($R_sG_sB_s$) transmitted during a scan period determined in accordance with the enable signal.

8. An apparatus as claimed in any of claims 1 to 7, wherein the reference signal generator (2) comprises an inverter (21) for inverting an enable signal (EN), and an AND gate (22) coupled to an output of the inverter (21) and to a clock signal (CK_1) to generate the reference signal (S_r).

9. An apparatus as claimed in any of claim 1 to 8, for transmitting over optical cables image signals output from a personal computer.

FIG. 1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5
52
LDA
51
LASER DRIVER
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Bs
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CK1
EN
VSYNC
HSYNC
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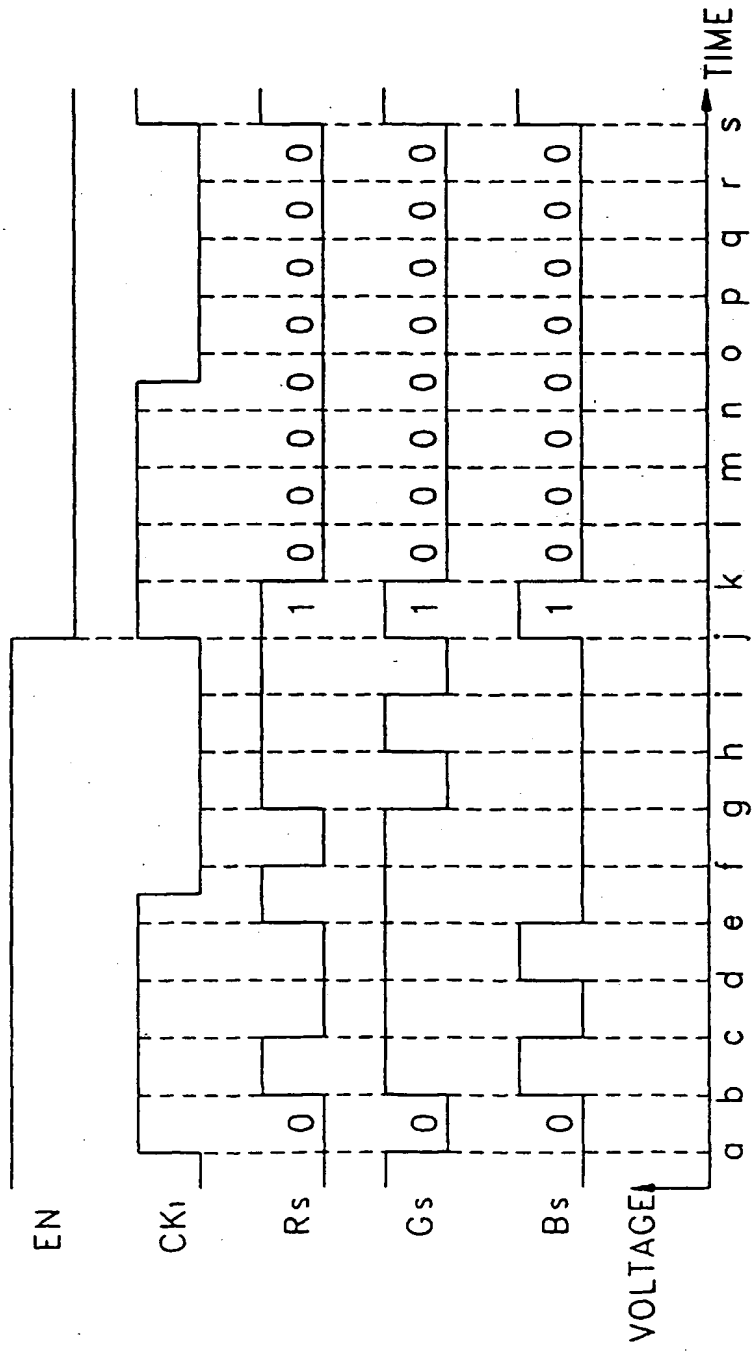
PARALLEL-TO-SERIAL CONVERTER
CK
CK2
CLOCK REGENERATOR
SR
22
Rp
Gp
Bp
2
21
CK1
EN
VSYNC
HSYNC
1
PERSONAL COMPUTER

FIG. 2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EUROPEAN SEARCH REPORT

Application Number
EP 99 30 8711

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 859 326 A (CANON KK) 19 August 1998 (1998-08-19) * column 9, line 5 - column 35, line 25 * ---	1-9	G06F13/00 H04N7/22
A	EP 0 578 416 A (LORAL AEROSPACE CORP) 12 January 1994 (1994-01-12) * column 3, line 15 - column 6, line 46 * ---	1-9	
A	US 5 410 363 A (CAPEN ROSS D ET AL) 25 April 1995 (1995-04-25) * column 4 - column 9, line 4 * -----	1-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

G06F
H04N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	31 January 2000	Materne, A

CATEGORY OF CITED DOCUMENTS

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31-01-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0859326 A	19-08-1998	JP 10285246 A	23-10-1998
		JP 10322413 A	04-12-1998
		JP 10322412 A	04-12-1998
		AU 5392198 A	27-08-1998
		CA 2229472 A	14-08-1998
		CN 1190838 A	19-08-1998
		EP 0859323 A	19-08-1998
		EP 0859324 A	19-08-1998
		EP 0859325 A	19-08-1998
		EP 0859327 A	19-08-1998
		JP 10290247 A	27-10-1998
EP 0578416 A	12-01-1994	US 5315424 A	24-05-1994
		CA 2097953 A	31-12-1993
		CA 2097960 A	31-12-1993
		JP 6095989 A	08-04-1994
		JP 6124252 A	06-05-1994
US 5410363 A	25-04-1995	NONE	

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